WATER CYCLE

The earth is sometimes known as the "water planet" because over 70 percent of its surface is covered by water. The physical characteristics of water influence the way life on earth exists. These characteristics include:

- Water is a liquid at room temperature, and remains as such over a relatively wide temperature range (0-100° C). This range overlaps the annual mean temperature of most biological environments.
- It takes a relatively large amount of energy to raise the temperature of water (i.e., it has a high heat capacity). For this reason, the vast oceans act as a buffer against sudden changes in the average global temperature.
- Water has a very high heat of vaporization. Water evaporation thus provides a good means for an organism to dissipate unwanted heat.
- Water is a good solvent for many compounds and provides a good medium for chemical reactions. This includes biologically important compounds and reactions.
- Liquid water has a very high surface tension, the force holding the liquid surface together. This enables upward transport of water in plants and soil by capillary action.
- Solid water (ice) has a lower density than liquid water at the surface of the earth. As a result ice floats on the surface of rivers, lakes, and oceans after it forms, leaving liquid water below where fish and other organisms can continue to live. If ice were more dense than liquid water, it would sink, and bodies of water in cold climates might eventually freeze solid.

All living organisms require water for their continued existence. The water cycle (hydrologic cycle) is composed of the interconnections between water reservoirs in the environment and living organisms and the physical processes (e.g., evaporation and condensation) involved in its transport between those reservoirs. The oceans contain about 97 percent of the total water on the planet, which leaves about three percent as fresh water. Most of the fresh water is locked up in glacial and cap ice or buried deep in the earth where it is economically unfeasible to extract it. One estimate gives the amount of fresh water available for human use to be approximately 0.003 percent of the total amount of fresh water. However, this is actually a more than adequate supply, as long as the natural cycle of water is not severely disturbed by an outside force such as human activity.

There are several important processes that affect the transport of water in the water cycle. Evaporation is the process by which liquid water is converted to water vapor. The source of energy for this process is usually the sun. For example, the sun's radiation heats the surface water in a lake causing it to evaporate. The resulting water vapor is thus added to the atmosphere where it can be transported to another location. Two important effects of the evaporation are cooling and drying.

Transpiration is a process by which water evaporates from living plants. Water from the soil is absorbed by a plant's roots and transported to the leaves. There, some is lost as vapor to the atmosphere through small surface openings.

When water vapor in the atmosphere cools, it can transform into tiny droplets of liquid water. This process is called condensation, and it can occur as water vapor is transported into the cooler upper atmosphere.

Dust and pollen in the atmosphere help to initiate the process by providing condensation centers. If the droplets remain small enough to be supported by air motions, they can group together to form a cloud. Condensation can also occur in the air near the ground as fog or on plant leaves as dew.

When condensed water droplets grow so large that the air can no longer support them against the pull of gravity, they fall to the earth. This is the process called precipitation. If the water droplets fall as liquid, it is called rain. If the temperature of the surrounding air mass is cold enough to freeze the water droplets, the resultant precipitation can be called snow, sleet or hail, depending upon its morphology.

Water falling on the ground (e.g., as precipitation or irrigation), can move downslope over the surface (e.g., surface runoff) or penetrate the surface (e.g., infiltration).

The amount of surface runoff and infiltration depends upon several factors: water infall rate, surface moisture, soil or rock texture, type and amount of surface cover (e.g., leaves and rooted plants), and surface topography. Surface runoff is the predominate process that occurs after precipitation, with most of the water flowing into streams and lakes. On a groundslope unprotected by vegetation, runoff can occur very rapidly and result in severe erosion.

Water that infiltrates the surface can move slowly downward through the layers of soil or porous rock in a process known as percolation. During this process, the water can dissolve minerals from the rock or soil as it passes through. The water collects in the pores of rocks as groundwater when it is stopped by an impermeable layer of rock. The upper limit of this groundwater is known as the water table and the region of water-logged rock is know as an aquifer. The groundwater may slowly flow downhill through rock pores until it exits the surface as a spring or seeps into a stream or lake.

Water is the essence of life. There would be no life as we know it without water. The vast oceans of water exert a powerful influence on the weather and climate. Water is also the agent by which the landforms are constantly reshaped. Therefore, the water cycle plays an important role in the balance of nature.

Human activity can disrupt the natural balance of the water cycle. The buildup of salts that results from irrigating with groundwater can cause soil infertility, and irrigation can also deplete underground aquifers causing land subsidence or salt water intrusion from the ocean. The clearing of land for farming, construction, or mining can increase surface runoff and erosion, thereby decreasing infiltration. Increasing human populations and their concentration in certain geographic localities will continue to stress water systems.

Careful thought is needed on local, regional and global scales regarding the use and management of water resources for wetlands, agriculture, industry and home.